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U.S. ATOMIC ENERGY COMMISSION

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ORNL-TM-1089

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THE CAPABILITY, CREDIBILITY, AND DESIRABILITY OF BLAST SHELTER SYSTEMS: A SYSTEM FOR ANALYSIS

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ORNL-TM-1089

Contract No. W-7405-eng-26

DIRECTOR'S DIVISION
Civil Defense Study Group

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MAY 1965

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ABSTRACT

This report distinguishes between grossly different types of blast shelter systems and the categories of variables relevant to their evaluation. It lists important variables (physical, physiological, psychological, cultural, economic, and political) for the categories, and where it is possible, scores alternative systems on each variable. For reasons listed in the report it is impossible to conclude on the basis of this report or at this time in the project that one system is clearly superior to the other systems.

1. INTRODUCTION

1.1 Objectives

The objective of this memo is to: (1) locate the categories of cost and gain[1] variables by which to evaluate types of blast shelter systems; (2) locate the variables for which each category is a function; and (3) indicate the extent to which the social sciences can and cannot at this time describe the operation of the variables vis-à-vis different types of blast shelter systems, i.e., the extent to which they can reliably evaluate the costs and gains of different blast shelter systems.

This memo is intellectually very gross. For example, when alternative blast shelter systems are evaluated in terms of stated variables, each variable is weighted the same as every other variable. Obviously, one variable may be much less efficacious in determining, for example, credibility, than another. At this point in the project it is impossible to fulfill the three objectives rigorously. However, this memo can fulfill its objectives grossly, i.e., chart major categories of cost and

[1] "Costs" and "gains" are used in the sense of welfare, not cost effectiveness, economics.

gain variables, locate some important variables in each category, and give some idea of the operation of the social science variables for alternative blast shelter systems.

1.2 Parameters

The reader should keep the following points in mind as he reads this memo:

(1) This memo discusses the costs and gains of a public, connected, flow system versus other types of blast shelter systems only. It does not discuss that system versus types of fallout or evacuation systems or versus other avenues out of the nuclear box, e.g., an antiballistic missile system. Therefore, it omits important cost and gain variables relevant to the latter comparisons only. For example, how does an extensive passive defense system as opposed to an antiballistic missile system affect the "objectivity" with which elites and publics evaluate threat? If passive defense distorts evaluations of threat (by exaggerating it) more than active defense, does an in-place, perceptually salient blast shelter system lead to a greater perceptual elaboration of threat or to a more biased search for evidence of its reality than an evacuation system? If so, how much greater?

(2) This memo is written by one social scientist. Therefore, it does not necessarily include the information available to and views of my social science colleagues. More importantly, in terms of the three objectives of the memo listed above, categories of an exclusively technological nature may be excluded; the variables of a technological nature may be incomplete or unusefully stated; and the operation of those purely technological variables for blast shelter systems is not described.

(3) As the last sentence indicates, this memo is not complete. Although it lists important technological variables, the writer is not competent to evaluate alternative systems in terms of them and must ask experts in the physical sciences to perform this task for her.

(4) Although alternative blast shelter systems are ranked numerically on some variables, it is illusory to think that adding up these numbers can indicate the usefulness of each system vis-à-vis all others.

The categories of variables are not weighted, and the variables within categories are not weighted. The operation of some variables is not known, and the operation of others has to be described by physical and biological scientists.

1.3 Types of Blast Shelter Systems

Before we discuss categories of variables, it might be helpful to distinguish between the types of blast shelter systems which are evaluated. The types are constructed from positions on three variables:

A: private (P) not private ($\overline{P}$)

The conventional and useful distinction between the private shelter and not private shelter is actually a composite of two variables: size and source of financing. The "private" position on this composite refers here to a shelter which can protect roughly 1-3 families and which is primarily privately financed. The "not private" position refers to a shelter which can protect a much larger number, from, let us say, 300 people to an entire urban population, and which is financed from public funds.

B: connected (C) not connected ($\overline{C}$)

The "connected"position on Variable B refers to protection units which have access to all other protection units in the system. The "not connected" position refers to protection units which are isolated from one another, except by means of surface routes.

C: flow (F) not flow ($\overline{F}$)

Connection is a necessary, but not sufficient, condition for flow. The "flow" position on variable C refers to connections which are also designed to expedite items through the connections. The "not flow" position refers to connections which are not especially designed to expedite items through the connections.

On the basis of these variables and the stated relationship between Variables B and C, we derive 6 types of blast shelter systems (PCF, $PC\overline{F}$, $P\overline{CF}$, $\overline{P}CF$, $\overline{P}C\overline{F}$, $\overline{PCF}$). The construction of only 4 of these 6 seems sufficiently plausible to warrant their evaluation: $P\overline{CF}$, $\overline{PCF}$, $\overline{P}C\overline{F}$, and $\overline{P}CF$.

2. CATEGORIES OF COST AND GAIN VARIABLES

2.1 Assumptions

We assume that three groups of actors[2] are relevant to an evaluation of any blast shelter system: technical specialists; potential inhabitants of the system; and policy-makers, i.e., actors who decide between alternatives. These groups are selected for these reasons: each group tends to define its professional or personal missions in such a way as to ask what seem to be the basic questions which must realistically be asked of alternative blast shelter systems. The technical specialist will tend to ask: "How capable is each system of performing the tasks for which it was designed?" The potential inhabitant will tend to ask: "How confident am I that this system will save me and the people I care about during an attack?" i.e., does it warrant learning about it and trying to get to it when a warning sounds? The policy-maker will tend to ask: "To what extent does each system help me to fulfill my public responsibilities and to protect my political neck?"

If we assume that these are the basic questions which must be asked of each blast system, we have, essentially, three categories of cost and gain variables: system capability, system credibility, and system desirability.

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[2] To be more exact, we are not really speaking of actors, but of roles which actors can assume, or "hats" which they can wear. Perhaps this is an unnecessary distinction to make at this level of generalization, except that if we do not make it, we are in the position of distinguishing between units which obviously overlap. For example, the technical specialist and the policy-maker are also potential inhabitants. What this example demonstrates is that an individual can play more than one role, or wear more than one hat, and that in essence our distinction between groups of actors is a distinction between hats, i.e., a distinction between analytic, not concrete, units.

2.2 Cost and Gain Variables Relevant to System Capability

System capability under certain hypothesized strategies of attack is a function of the extent to which:

1. the system provides life-function necessities during and after attack:
   a. heat removal
   b. CO control
   c. blast attenuation
   d. immediate and delayed radiation protection
   e. fallout ingress protection
   f. efficient storage and preparation of food and liquid
   g. waste removal
   h. facilities for restful sleep
   i. balanced locomotion
2. system components are technically simple;
3. system entrance components are conducive to disciplined and rapid loading of human components in the time which the assumed strategies of attack allow;
4. the system is conducive to target dispersion;
5. system exit components are reliable and located, preferably, away from potential quantities of rubble and from potential areas of high fallout;
6. system components are easily fabricated and dispersed;
7. the system is easily assembled;
8. the system requires an infrequent and uncomplicated maintenance schedule;
9. the system is lower in dollar costs than other systems.

2.3 Cost and Gain Variables Relevant to System Credibility

System credibility is a function of the extent to which:

1. the system does not disrupt the individual's life-space during its construction;
2. the system accords equal protection to those who consider themselves potential targets;

3. the system is conducive to painless knowledge of where one enters the system and how it works once one is in it;
4. the system apparently can tolerate the physical effects of the attack strategies commonly hypothesized by information sources trusted by the individual;[3]
5. the system apparently provides life-function necessities;
6. the system apparently provides a psychologically tolerable life-space;
7. system entrances are sufficiently proximate to potential inhabitants, given the warning times assumed by information sources trusted by the individual;
8. system entrances are sufficient in number in each area to load potential inhabitants without creating a perception of a need to compete to enter;
9. the system can reunite potential inhabitants with valued others, if they are separated from each other at the time of warning;
10. the system can distribute and aggregate human resources, especially skill resources such as medical;
11. the system is apparently integrated with and contributes to apparently feasible postattack recovery plans.

2.4 Cost and Gain Variables Relevant to System Desirability

System desirability is a function of the extent to which:

1. the system is not vulnerable to foreseeable changes in offensive systems;
2. the system is capable under certain hypothesized strategies of attack;
3. the system helps to deter both counterforce and countervalue attacks;
4. the system helps to deter countervalue attacks only;
5. the system is conducive to arms control;

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[3] Popular credibility is the product of a usually lay evaluation of the system, and what may seem to be, for example, a technically capable system to the lay individual may be known by the trained engineer to have serious deficiencies.

6. the system helps to restrict the diffusion of nuclear weapons;
7. the system is conducive to alternative preattack uses;
8. the system costs less in dollars than other systems;
9. the system, when it is implemented, does not require heavy expenditure of the Administration's political credits with Congress, the federal, state, and local bureaucracies, pressure groups, and the public;
10. the system does not disrupt the life-spaces of influentials during its construction;
11. the system services significant others (influentials and essential human resources) during certain hypothesized strategies of attack;
12. the system requires little or no public conditioning to operate efficiently during attack;
13. the system is credible to potential inhabitants;
14. the system is conducive to command and control of potential inhabitants;
15. the system is conducive to distribution and aggregation of essential human resources;
16. the system contributes to hypothesized postattack recovery plans.

3. EVALUATION OF ALTERNATIVE SYSTEMS IN TERMS OF COST AND GAIN VARIABLES

3.1 Assumptions

Before we begin evaluating the systems, the reader should note two points:

(1) Each system is scored for each variable on a 0-4 scale. Four (4) is at the positive pole of the scale; zero (0) is at the negative pole; and

(2) Even when a system is scored on a variable, i.e., is not scored "unknown" (U), the reader is reminded that these scores are tentative and based on assumptions which may be incorrect or incomplete.

3.2 Evaluation of Capability of Alternative Systems

3.2.a Table I

Variable	$\overline{PCF}$	$\overline{PCF}$	$\overline{P}\overline{CF}$	$\overline{P}CF$
1a	To be evaluated by:	physical scientists; physiologists		
1b	"	"		
1c	"	"		
1d	"	"		
1e	"	engineers		
1f	"	engineers; man-machine psychologists		
1g	"	"		
1h	"	"		
1i	"	"		
2	"	engineers		
3	"	man-machine psychologists		
4	0	0	2(?)	4
5	1	1	4	4
6	To be evaluated by:	engineers		
7	"	"		
8	"	"		
9	"	"		

Key: 1a: heat removal. 1b: CO control. 1c: blast attenuation. 1d: radiation protection. 1e: fallout ingress protection. 1f: food and liquid storage, preparation. 1g: waste removal. 1h: restful sleep facilities. 1i: balanced locomotion. 2: simple components. 3: rapid, disciplined loading. 4: target dispersion. 5: reliable exits away from rubble, fallout. 6: easily fabricated, dispersed components. 7: easy assembly. 8: easy, infrequent maintenance. 9: dollar costs.

3.2.b Observations on Table I

1. The four systems, or at least the three $\overline{P}$ systems, may not vary at all on certain dimensions. For example, it would seem that entrance components conducive to blast attenuation and disciplined and rapid loading could be "glued" onto any system and are not necessarily peculiar to any one system.

2. Although some of the life-function necessities can be provided by one system as easily as by another, the connected systems have an advantage over the unconnected systems in that they duplicate the provision of life-function necessities.

3. Variable 1e (fallout ingress protection): This variable refers to the ability of the system to isolate fallout brought in on people's clothing or through breaches in the system. It is not entirely clear that more human carriers of fallout would enter the $\overline{P}$ than the P shelter. Certainly the $\overline{P}$ shelter contains more people who could leave and return than the P type. However, the $\overline{P}$ shelter is more apt to house instruments that can monitor the state of the external environment and individuals trained in command and control. A $\overline{P}$ shelter is probably amenable to more elaborate and reliable decontamination facilities than the P shelter. Unless the $\overline{P}\overline{C}\overline{F}$ and $\overline{P}CF$ systems can be modified to handle this particular problem, fallout which sifts in through breaches in the system is much more apt to contaminate a smaller proportion of a $\overline{PCF}$ than a $\overline{P}\overline{C}\overline{F}$ and $\overline{P}CF$ system.

4. Variable 1h (balanced locomotion): This variable is relevant only to connected systems of tubular construction. There is some evidence which suggests that a tubular life-space impairs the equilibrium of the individual when he is moving. This can be corrected by building into the system vertical reference points. Probably the Navy has had to deal with this problem in their submarines, and the Polaris group at Groton, Connecticut, should have information on this.

5. Variable 3 (rapid, disciplined loading): Since a private shelter is assumed to accommodate very few people, its loading problem is minimal. Its entrance need not be nearly as carefully designed to expedite human traffic.

6. Variable 4 (target dispersion): The $\overline{P}CF$ system obviously falls at 4 on this variable. Since the $\overline{P}C\overline{F}$ system is connected, it can be used to disperse population. However, it is assumed that since it was not designed specifically for rapid flow of population within the system, design features which impede a rapid flow will not have been eliminated and special flow mechanisms, such as conveyor belts, will not have been added. Therefore, it should fall below 4 on this variable, but above the 0 for the $P\overline{CF}$ and $\overline{PCF}$ systems.

7. Variable 5 (reliable exits away from rubble, fallout): The $\overline{P}CF$ and $\overline{P}C\overline{F}$ systems fall higher on this variable than the other two systems. They both obtain some exit reliability because they duplicate exits, and, assuming that their connections extend into the suburbs, some exits in the systems could be located away from areas of potentially massive rubble and potentially high fallout.

3.3 Evaluation of Credibility of Alternative Systems

3.3.a Table II

Variable	$P\overline{CF}$	$\overline{PCF}$	$\overline{P}C\overline{F}$	$\overline{P}CF$
1	U*(3)	U(2)	U(1)	U(1)
2	0	4	4	4
3	4	U (less than 4)	U (less than 4)	U (less than 4)
4	U	U	U	U
5	2	2	4	4
6	U	U	U	U
7	0-4	4	4	4
8	2	4	4	4
9	0	0	4	4
10	0	1 or 2	4	4
11	U(1)	U(2)	U(3)	U(3)

*U = unknown.

Key: 1: life-space disruption. 2: equality of protection. 3: knowledge of system. 4: system tolerance. 5: life-function provisions. 6: tolerable life-space. 7: entrance proximity. 8: entrance sufficiency. 9: reuniting possibilities. 10: distribution, aggregation of human resources. 11: postattack recovery.

3.3.b Observations on Table II

1. Variable 1 (life-space disruption): Unknown. If we assume that, particularly in urban areas, a large number of individuals would be unable to construct a private blast shelter, then probably an adequate $\overline{P}$ blast shelter system would disrupt more life-spaces. Of this type, probably the connected type of mass shelter would disrupt a greater area of these life-spaces. To answer this adequately, we would need to know for each city:

   a. the plan and schedule of construction of the system;
   b. the types of life-spaces for individuals in that city; and
   c. the values attached by individuals to parts of each type of life-space. (We assume that disrupting certain parts of the life-space is much less salient to the individual than disrupting other parts.)

2. Variable 2 (equality of protection): Particularly in urban areas, which are most relevant to blast systems, the $\overline{PCF}$ system will not accord equal protection to all individuals who consider themselves potential targets, if only for monetary reasons. All $\overline{P}$ systems in theory can provide equal protection.

3. Variable 3 (knowledge of system): Unknown for $\overline{P}$ shelters. The extent to which the system is conducive to painless knowledge depends in part on the type of dual use which is selected for it. (If the comment for variable 12, system desirability section—see below—is correct, we can argue that the connected systems score higher on this variable than the $\overline{PCF}$ system.) However, knowledge will probably never be as complete for $\overline{P}$ as for P shelters.

4. Variable 4 (system tolerance): Unknown. The nature of the socres on this variable will depend largely on:

   a. the actual capability of the system;
   b. the evaluation of its capability by information sources trusted by the individual; and
   c. the extent to which the individual assumes that no system can tolerate the effects of thermonuclear war.

5. Variable 5 (life-function provisions): Theoretically, it is possible for all systems to provide life-function necessities. However, the connected systems provide more options for obtaining these necessities, and, all other things being equal, would be perceived as more able to provide them than the isolated unit. Thus, they are rated higher on this variable than the two nonconnected systems.

6. Variable 6 (tolerable life-space): Not known reliably. Size: In the various shelter simulation studies the experimental groups apparently adjusted to very limited life-spaces. If, for this variable, we can extrapolate from these groups to the American population, this is a useful datum for the engineer who is concerned about the operation of human beings once they are in the system. However, this datum does not tell us whether or not individuals without a clinically demonstrable fear of confined spaces and without the shelter experience will think that the confined life-space of a shelter would be psychologically distressing. The "think" is the relevant concept to system credibility. Some simulation studies report that volunteers anticipated that they would find the confined life-space upsetting. (Note: Whatever a random sample of Americans anticipates about the size of the life-space in a shelter, these anticipations probably do not vary with the different types of mass shelters. They may vary with the family shelter in the sense that the individual may feel that he has more control over the size of his life-space because he has more control over the size of the total shelter.)

Shape: There is some evidence that tubular life-spaces impair the individual's sense of equilibrium when he is moving. Obviously, this datum is particularly relevant to the $\overline{\text{PCF}}$ system, if it is constructed out of tubular sections. The extent to which an individual anticipates that such a system will upset him psychologically depends largely on whether:

a. the individual has driven or walked through tubular spaces, such as tunnels;
b. engineers have put vertical reference points into the tube to alleviate the equilibrium problem;
c. the problem and its solution are made explicit through the individual's information sources; and

d. the unfamiliarity of a tube as a life-space is in itself frightening.

7. Variable 7 (entrance proximity): Obviously, the $\overline{PCF}$ system can fall at any point on this variable, from 0-4. Theoretically, all of the $\overline{P}$ shelter systems can fall at 4 on this variable. The extent to which the individual will perceive entrances as sufficiently proximate will depend in part on whether:

a. the entrances <u>are</u> sufficiently proximate for a random sample of the population, given certain assumptions about warning time. When the maximum distance between the individual and an entrance are calculated for any system, at least three variables should be considered:

- types of physical conditions of the population, relevant to their ability to move, e.g., the arthritic walk of the elderly; the uncoordinated walk of the very young.
- types of psychological responses to warning which delay the response to move.
- types of environments between the individual and the entrance, e.g., <u>vertical</u> and horizontal distance between the individual and an entrance; population density of streets and sidewalks, etc.

b. the individual believes that he will have available to him the assumed warning time. If he imagines nuclear war as out-of-the-blue war, a derivative assumption tends to be no warning time. In this case, no entrance is proximate enough for the individual, except perhaps one in his backyard or next door to his office.

8. Variable 8 (entrance sufficiency): The $\overline{PCF}$ falls quite low on this variable, as evidenced by the debate over family shelters. The anticipation that aliens will compete to enter the family shelter probably derives as much from projection of such behavior onto aliens as from the actual possibility of such behavior. I suggest that individuals anticipate, at least preconsciously, that it will be distressing to save one's own skin at the expense of others. Very grossly, this negative evaluation of one's own behavior becomes projected as a negative evaluation of aliens' behavior. Therefore (if this hypothesis is correct),

even if it can be demonstrated that aliens would not behave competitively, a more potent source of the individual's anticipations will not be removed, and the family system will not move up on this variable.

Theoretically all $\overline{P}$ shelters can provide a sufficient number of entrances, as long as the population densities of various areas are accurately calculated and the volume of agitated traffic which can safely go through the proposed type of entrance in a certain period of time is known.

9. Variable 9 (reuniting possibilities): The $\overline{PCF}$ and $\overline{\overline{PCF}}$ systems fall at zero on this variable. The $\overline{P}CF$ and $\overline{P}\overline{CF}$ systems will probably be perceived as falling at 4 on this variable if:

a. it can be demonstrated that if parts of the system are cratered, it does not lose its connectedness characteristics; and

b. it connects the work area(s) with their bedroom communities and with the schools which service both.

10. Variable 10 (distribution, aggregation of human resources): Probably the shelter population of a $\overline{PCF}$ system is (and will be perceived as) more apt to include essential skills, e.g., medical, than a P shelter. With this exception, variable 10 operates similarly to variable 9. In this case it is essential that the system connect hospitals, medical centers, police headquarters, fire and disaster stations, etc., with residential, other work, and school areas.

11. Variable 11 (postattack recovery): Unknown. Essentially we have no postattack plans. This is probably an important variable because a shelter system of any type is usually perceived as a means to an end of recovery, or at least the initiation of recovery. If a shelter system is not coordinated with what seem to the population as feasible recovery plans, the credibility of the shelter system itself will probably decline. All other things being equal, however, probably the $\overline{P}CF$ and $\overline{P}\overline{CF}$ will fall higher on this variable than the $\overline{\overline{PCF}}$, and certainly than the $\overline{PCF}$, because the former two systems seem to be a closer analog to preattack society.

3.4 Evaluation of Desirability of Alternative Systems

3.4.a Table III

Variable	$P\overline{CF}$	$\overline{PCF}$	$\overline{P}\overline{CF}$	$\overline{P}CF$
1	To be evaluated by: weapons systems analysts			
2	Determined by total weighted score for each system on system capability sheet			
3	U (probably lower score than for mass systems)	U	U	U
4	U (probably lower score than for mass systems)	U	U	U
5	U (probably lower score than for mass systems)	U	U	U
6	U (probably lower score than for mass systems)	U	U	U
7	U (probably lower score than for mass systems)	U	U	U
8	To be evaluated by: engineers			
9	4	2	1	1
10	3	2	1	1
11	1	3-4	4	4
12	4	1-3	2-3	2-3
13	Determined by total weighted score for each system on system credibility sheet			
14	2	2	3	3
15	0	2	3	4
16	U(0)	U(1-2)	U(3)	U(4)

Key: 1: system obsolescence. 2: system capability. 3: deterrence value: counterforce, countervalue. 4: deterrence value: countervalue. 5: arms control. 6: nuclear diffusion. 7: dual use possibilities. 8: dollar costs. 9: political costs. 10: disruption of influentials' life-space. 11: protection of significant others. 12: public conditioning. 13: system credibility. 14: command and control. 15: distribution, aggregation of human resources. 16: postattack recovery.

3.4.b Observations on Table III

1. Variable 2 (system capability): The total weighted capability score for each system can be derived from the system capability sheet when it is completed and placed on a 0-4 scale.

2. Variables 3 and 4 (deterrence value: counterforce and countervalue; countervalue only): Unknown. The deterrence value of all 4 systems depends entirely on the content of certain categories of perceptions held by potential aggressors of the systems. Some relevant categories of perceptions are these:

   a. military capability, or the extent to which the system can nullify the gains to an aggressor of an attack on the United States. Probably the $\overline{PCF}$ system would be perceived as not as capable as any of the $\overline{P}$ systems because it would not protect large numbers of people. The variation in military capability of $\overline{P}$ systems is not known at this point. At this gross level of generalization the important increment in military capability would seem to be between blast shelters and fallout shelters, not between blast shelters themselves.

   b. aggressor perceptions of intentions, or what we plan to do with the system (what we think it lets us do which we were unable to do before). Probably American policy-makers would not perceive the $\overline{PCF}$ system as sufficiently militarily capable to create significant new options. It is unknown now what options might be created by $\overline{P}$ systems and how these options might vary with the type of system. How our decision-makers' perceptions and manipulations of their options are interpreted by foreign aggressors is also not known.

3. Variable 5 (arms control): Unknown. The systems most conducive to the risk-taking associated with arms control are probably those which have the highest <u>weighted</u> capability and credibility scores, in case the gamble fails and the system must be used. The $\overline{PCF}$ system has perhaps one other advantage: the target population can be dispersed to peripheral areas. This characteristic may make American leaders feel that they

have extra time in which to decide what the enemy is doing and to select an appropriate response. How much "extra time" is needed before it becomes significant in these terms is not known.

4. Variable 6 (nuclear diffusion): Unknown. A significant blast system of any type will probably help to restrict the diffusion of nuclear weapons only in the case of the small n-country which wants to build weapons to blackmail the United States. Evidence on the developing countries indicates that this will not be a basic motive in starting a nuclear weapons construction program. The motives will probably not be that specific, and therefore a specific feature of our defensive system such as blast shelters will probably not frustrate the initiation of such a program. The evidence indicates that the motives will be the desire to buy with nuclears such generalized "goodies" as prestige, potence, independence, identification with the technologically advanced sectors of the world, etc. To the extent that blackmailing the United States does prove to be an initial motive, the best diffusion-deterring system is that which we and foreign elites regard as the most capable and credible and that which allows us to communicate to the world that any nation which tries to blackmail us will pay very dearly.

5. Variable 7 (dual use possibilities): Unknown. All systems are conducive to alternative preattack uses. A guess is that the connected systems are conducive to alternative uses which solve more interesting, thornier, and more looming urban problems than the $\overline{PCF}$ and $P\overline{CF}$ systems. At the same time, it is more difficult to make these uses feasible. <u>If</u> one can be made feasible, the connected systems would probably fall higher on this variable than the unconnected systems. The $P\overline{CF}$ system would probably fall lower on this variable than the $\overline{PCF}$ system because from the policy-maker's point of view, its alternative use would not have as large a multiplier effect on public welfare as that of a $\overline{P}$ system.

6. Variable 8 (dollar costs): Obviously dollar cost should be adjusted to account for the alternative use(s) to which the system is conducive.

7. Variable 9 (political costs): If we extrapolate from the reaction to the private shelter program during the Kennedy administration, a $P\overline{CF}$ system costs the Administration with the public, but not with customary pressure groups, local, state and federal bureaucracies, and not as heavily with Congress as an expensive, federally initiated $\overline{P}$ system would probably cost. Therefore, the $P\overline{CF}$ system probably falls at 3 on this variable. Unless the implementation of a $\overline{P}$ system is in response to an intensive national felt need, the $\overline{P}$ systems probably all fall below 3 on this variable: they imply that some combination of the federal, state and local governments assumes at least the responsibilities of financing, constructing, stocking, mass and managerial training for, and maintaining the system. Exactly where they fall between 0 and 2 and whether they fall differentially between 0 and 2 are not known.

8. Variable 10 (disruption of influentials' life-space): On the average, the $P\overline{CF}$ system probably disrupts the life-spaces of influentials the least, the $\overline{PCF}$ system more, and the $\overline{P}\overline{CF}$ and $\overline{P}C\overline{F}$ systems the most.

9. Variable 11 (protection of significant others): $\overline{P}$ systems probably fall higher on this variable than the private option, even though influentials are more apt to be able to afford a private shelter. The $\overline{P}$ systems do not necessarily vary on this dimension. Theoretically, either of the connected systems could service significant others, and if significant others group at all in the working and residential areas, it would be possible to place $\overline{PCF}$ close to them. (Insignificant others might perceive this arrangement as discriminatory, i.e., unequal protection.) Where significant others do not group conveniently, the connected systems might fall higher on this variable if the $\overline{PCF}$ shelters are large and infrequent, rather than small and frequent.

10. Variable 12 (public conditioning): Obviously the $P\overline{CF}$ option falls at 4 on this variable. The scores for the other systems depend in part on the alternative uses devised for them. The connected systems seem more conducive to alternative uses which would involve a larger proportion and better cross section of the urban population than the $\overline{PCF}$ system. For example, if the connected systems could be used as patroled walkways, heated walkways, rapid transit tubes, etc., more people would tend to use the system more often and would learn its entrance locations

and internal design more easily. Alternative uses suggested for the $\overline{PCF}$ system seem more specialized, e.g., garages, teenage recreation halls, storerooms, lecture halls. If you do not own a car or do not drive one, if you are not or do not have teenagers, if you are not a local government secretary who wants to store some files in the government storeroom, or if you prefer to watch TV to going to lectures, you will know much less about the locations and internal design of shelters and will need special education.

11. Variable 13 (system credibility): The total credibility score for each system can be derived from the system credibility sheet when it is completed and placed on a 0-4 scale.

12. Variable 14 (command and control): Command and control are a function of several variables, but perhaps the most important ones can be subsumed under a variable of group size and one of availability of problem-solving personnel (e.g., trained leaders, doctors, mechanics).[4] The $P\overline{CF}$ system is scored at 2 on this variable: the size of the group is very small and therefore easily controlled. However, personnel who, by virtue of formal training or personal characteristics, are able to cope with the problems that can reasonably be expected to arise in the shelter situation are minimally available. The $\overline{PCF}$ system is also rated at 2: the group is much larger and therefore harder to control. On average, the availability of problem-solving personnel is greater. However, the demography of an area and the isolated nature of the shelter units can combine to concentrate types of problem solvers in a few shelters and to isolate them from the inhabitants of many others. The $\overline{P}\overline{CF}$ and $\overline{P}CF$ systems are both scored at 3: the group is large; the ability of, and sometimes the necessity for, individuals to move through the system can complicate command and control; the probable tubular construction of each system can pose assembly problems and can make it difficult for the authority figure to see the individuals whose behavior he is monitoring and for them to see him. On the other hand, because of the connectedness of the system, the leadership have many more life-space options and problem-solving personnel available to them.

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[4] These two variables are separated because the availability of problem-solving personnel is only <u>partly</u> a function of the size of the group.

13. Variable 15 (distribution, aggregation of human resources): The $\overline{PCF}$ falls at 0 on this variable. The size of the sheltered group is very small and has no way of combining with like or larger groups. The $\overline{PCF}$ system is scored at 2: although the inhabitants of individual shelters cannot reach other units, they are more apt to have among themselves individuals with useful personal and vocational skills. Theoretically, a $\overline{PCF}$ unit also shelters a significant amount of manpower. The $\overline{P}C\overline{F}$ system is scored at 3 because of its connectedness feature, and the $\overline{P}CF$ system at 4 because of its connectedness and special flow design features.

14. Variable 16 (postattack recovery): Unknown. In the absence of stated national recovery plans, one can only suggest, all other things being equal, that the $\overline{P}CF$ system falls at 4 on this variable. Its connectedness feature simulates the social network of preattack society, and its flow characteristics expedite the execution of postattack recovery plans. The $\overline{P}C\overline{F}$ and $\overline{PCF}$ systems fall at 3 and 1-2 on this variable, respectively. The $PC\overline{F}$ system falls at zero because the microscopic, isolated social group which it preserves is not conducive to postattack recovery.

4. POSTSCRIPT

The writer would like to reiterate that this memo is very general, very tentative, and primarily an instrument to stimulate communication between and research by members of the project. I also reiterate that this memo compared the capability, credibility, and desirability of alternative blast shelter systems only. Ergo, it omits variables which are crucial to the evaluation of the capability, credibility, and desirability of civil defense per se, e.g., the variable of the probability that the system will be needed. Obviously this evaluation is the one which is the most important in the study of passive defense.

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